

RP 101 Wind Turbine Gear Lubricant Flushing Procedures

The following recommended practice (RP) is subject to the disclaimer at the front of this manual. It is important that users read the disclaimer before considering adoption of any portion of this recommended practice.

This recommended practice was prepared by a committee of the AWEA Operations and Maintenance (O&M) Committee.

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Purpose and Scope

The scope of “Wind Turbine Gear Lubricant Flushing Procedures” addresses the proper methods of wind turbine gearbox flushing and oil conversion procedures to optimize oil change quality and prevent carryover of additives sludge and debris from used oil to new oil.

There are numerous wind turbine gear lubricant oil system types, however this paper will focus on a commonly used lubrication system. The general procedures can easily be adapted to other lubrication systems with similar results. Base oil types associated with this Recommended Practice are Polyalphaolefin (PAO) and Petroleum oil (mineral oil). Other base oil types are not associated with this paper.

Introduction

Sludging on internal wind turbine gearbox components is common. If these components are not cleaned or flushed properly during an oil change, the quality of the new gear lubricant is compromised causing poor future performance.

Simply draining and filling a wind turbine gearbox may not be adequate. Doing so might leave deposits which could cause new oil foaming, increased wear such as micropitting, shortened oil life, and make oil analysis difficult to interpret due to used gear lubricant additive carryover into the fresh gear lubricant. Specific flushing procedures are required to optimize oil change gear lubricant quality.

Flushing Procedures

1. Preparing the Gearbox for the Oil Change

1.1. Take an oil sample of the current used gear lubricant from the gear box at the recommended location, following established sampling procedures. All samples should be taken from the same location consistently. Purge the oil sample port to ensure respective sample is taken.

1.2. A cleaner may be added to loosen up dirty or sludgy gearbox deposits and assist in the flushing process. Consult with the oil supplier for direction as to the specific type and proper usage of cleaner.

2. Draining the Used Gear Lubricant from the Gearbox

2.1. Take an oil sample.

2.2. Fabricate a drain plug with the correct fitting to adapt to a drain hose. (See *Figure A*)

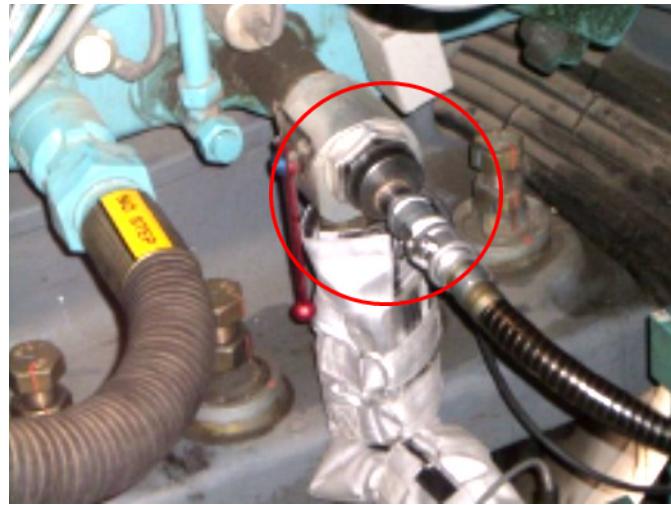


Figure A

2.3. Connect the used oil hose to the reservoir drain valve.

2.4. Connect this hose to the waste oil tank at the lube truck.

2.5. Start draining the gearbox oil by opening the valve. Draining of used oil is aided by using a pump, vacuum, or both.

2.6. Open the oil filter housing, discard the used oil filter, and thoroughly drain the filter housing.

2.7. Clean the inside of the filter housing by hand. (See *Figure B*)



Figure B

2.8. Remove the by-pass pressure release valve and hose next to the gearbox heat exchanger/cooler and drain any oil in the hose. (See *Figure C*)



Figure C

2.9. Clean the by-pass pressure release valve by hand with spray cleaner (i.e. Brake Clean).

2.10. Re-install the by-pass pressure release valve and hose next to the gearbox heat exchanger.

2.11. Remove the thermostatic by-pass valve block which is found on the bottom of the filter housing and clean by hand. (See *Figure D*) Then remove the thermostat assembly from the thermostat block and clean. (See *Figure E*)

CAUTION: Do not remove the brass pin from the thermostat barrel.

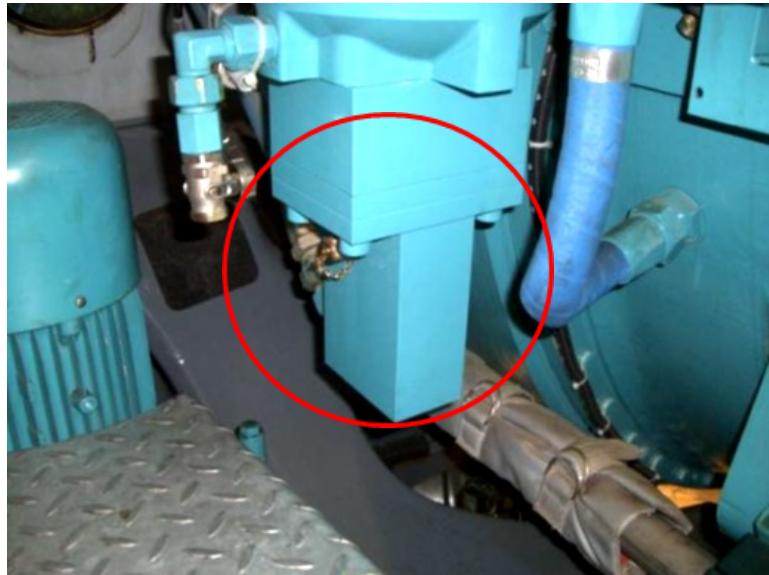


Figure D



Figure E

2.12. Re-install the thermostatic by-pass valve assembly and block.

2.13. Remove the hose from the system relief valve located between the filter housing and oil pump and drain any oil from the hose. (See *Figure F*)



Figure F

2.14. Remove the system relief valve and clean if needed.

2.15. Re-install the relief valve.

2.16. Remove the 2-inch plug at the top of the gearbox planetary. (See *Figure G*) Purge/spray the gearbox planetary with approximately 5 gallons of new gear lube.



Figure G

- 2.17. Re-install the 2-inch plug at the top of the gearbox planetary.
- 2.18. Continue to drain the oil from the gearbox.
- 2.19. Through the gearbox inspection cover (See *Figure H*), purge/spray the interior gearbox housing, gears, bearings, and shafts using 5-gallons of new gear lubricant.

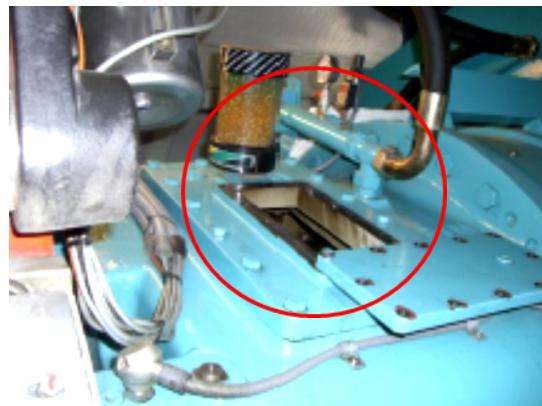


Figure H

- 2.20. Continue to drain the oil from the gearbox.
- 2.21. Close the gearbox drain valve.
- 2.22. Place a drain pan under the gearbox drain valve and open the valve.
- 2.23. Use a magnet to swab the gearbox through the drain port for any metallic wear debris.
- 2.24. Reconnect the hose to the drain port and open the drain valve.
- 2.25. Drain the external heater, if so equipped. (See *Figure I*)



Figure I

2.26. Disconnect the oil level sensor and clean.

2.27 Take the top of the oil float level housing off and clean out the sensor housing and oil float indicator by hand. (See Figures J and K)



Figure J



Figure K

2.28. Install a new gasket for the oil sensor container.

2.29 Re-install the oil level sensor.

2.30. Install a dedicated flush filter. This flush filter can be reused for up to 5 turbine oil changes during the flush and rinse phases only.

2.31. Re-install the gearbox inspection cover.

3. Flushing Phase

- 3.1.** Prior to flushing the gearbox, all oils located on the oil change truck/trailer need to be filtered with a 5 micron filter to keep any possible debris from the lube truck tanks or oil transfer from entering the gearbox.
- 3.2.** Close the gearbox drain valve.
- 3.3.** Fill the gearbox to the recommended oil level with gear lubricant.
- 3.4.** Turn on the heater pump to circulate the oil in the heater sump, if so equipped.
- 3.5.** Turn on the gearbox lubrication pump and let the turbine pinwheel for up to 60 minutes at low speed. This is to be done with NO Load.
- 3.6.** Take a one-quart sample of gear lubricant from the gearbox and label *Flush Sample*, and include turbine number and date on the bottle.
- 3.7.** Repeat Steps 2.5 through 2.31 from “*Draining the Used Gear Lubricant in the Gearbox*” section of this document. Re-clean the bypass pressure release valve, the thermostatic bypass valve block, the system relief valve, and the oil level sensor only as required.

4. Rinsing Phase

- 4.1.** Prior to rinsing the gearbox, all oils located on the oil change truck/trailer need to be filtered with a 5 micron filter to keep any possible debris from the lube truck tanks or oil transfer from entering the gearbox.
- 4.2.** Close the gearbox drain valve.
- 4.3.** Fill the gearbox to the recommended oil level with gear lubricant.
- 4.4.** Turn on the heater pump to circulate the oil in the heater sump, if so equipped.
- 4.5.** Turn on the gearbox lubrication pump and let the turbine pinwheel for up to 30 minutes at low speed. This is to be done with NO Load.
- 4.6.** Take a one-quart sample of gear lubricant from the gearbox and label *Rinse Sample*. Include turbine number and date on the bottle.
 - 4.6.1.** Repeat Step 3.7. Close the gearbox drain valve.
 - 4.6.2.** EXCEPTION FROM Step 2.29: Install new gear lubricant filter for final fill phase. Retain flush filter for re-use up to 5 times.

5. Final Fill Phase

- 5.1.** Close the gearbox drain valve.
- 5.2.** Pump up new, filtered gear lubricant until the gearbox sump reservoir is full as indicated by the gearbox sight glass.
- 5.3.** Install a new desiccant filter/breather.
- 5.4.** Inspect the gearbox inspection cover gasket and replace if necessary.
- 5.5.** Turn heater pump and lube oil pump on to circulate gear lubricant throughout the system. Turn off pumps and re-check the oil level to ensure oil level is between the low and high-level indicators. Top up as needed.
- 5.6.** Turn on the gearbox lubrication pump and let the turbine pinwheel for 15 minutes at low speed and with NO Load.
- 5.7.** Take a one-quart oil sample and label *Final Fill* and include turbine number and date on the bottle. Check for oil leaks at all fittings and connections.
- 5.8.** Check the oil level 30 minutes after shutting the turbine down to ensure the gearbox oil is at full indicator.
- 5.9.** Clean up and affix new oil label on the gearbox.

Summary

Some wind turbine gearboxes are particularly dirty from deposits left by specific gear lubricant breakdown and/or outside contaminants. It is important to understand that a good flushing process includes draining the gearbox and all associated areas. These areas include: hoses, thermostat, oil float indicator, check valves, heater, and cooler. Neglecting to address all of these areas that are known to hold old contaminated gear lubricant will result in diminished new oil quality. It is also very important to manually clean all sludged surfaces such as: filter housing, check valves, oil float indicator, and thermostat. This is to assure that contaminants are not carried over to the new gear lubricant.

Summary
(continued)

By evaluating oil analysis comparisons between the used gear lubricants, flush, rinse and final fill gear lubricant samples, it is possible to determine final fill gear lubricant quality. The oil analysis used to properly evaluate the gear lubricant samples should include:

- Viscosity
- List of items
- ICP Analysis
- Water PPM
- Particle Counting
- Foam testing

Foaming is not normally tracked during regular oil analysis; however, during the flushing procedures it is important to understand that residual components left from the used oil can cause foaming in the new gear lubricant. Although additive concentrations in the used gear lubricant are normally flushed adequately by the end of the Flush Phase, foam values may still remain and show up in oil analysis until after the Rinse Phase. This indicates that the Rinse Phase is necessary and provides a better final fill gear lubricant quality.